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MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY

Communicated by E. B. TITCHENER, H. P. WELD and K. M. DALLENBACH

XLVIII. A NOTE ON THE SERIES OF BLACKS, GREYS, AND WHITES

By F. L. DIMMICK

G. E. Müller's exposition of the four color-series as "series of psychical qualities" has been generally accepted, and the arrangement of the series in a quadrilateral, which forms the base of the color-pyramid, is shown in many text-books. Müller, however, as is well known, regards the black-white series as a fifth qualitative series of the same order; and he holds to this view despite the antagonism of the black and white processes which is apparent in the effects of after-image and contrast. Further, this single series shows two lines of intensities between its terminal qualities, seeing that intensity increases in both directions outward from the middle grey.¹

It may, however, be doubted whether, in the case of the black and white series, the last word of observation has yet been said. If this series is compared with a double series extending from blue through grey to the antagonistic yellow, or from green through grey to the antagonistic purple, a likeness emerges which, although masked by the achromatic quality of the blacks, greys, and whites, becomes more and more pronounced as the three groups are longer studied. Indeed, it is the purpose of this Note to suggest that the black-white series is, in reality, made up, not of a single qualitative series in Müller's sense, but rather of *two series*, which join each other at an angle of 180°. The one of these series runs from white to grey through the light or whitish greys, the other runs from black to grey through the dark or blackish greys. In a light grey there is a likeness to (or a reminder of) both white and grey; there is no hint of black. Similarly, in a dark grey there is resemblance to (or reminder of) both black and grey; there is not the least hint or trace of white. If once grey has established itself to observation as an independent quality, the terminal quality of qualitative series, then the continuity of the black-white line is immediately resolved, and the two component series, black-grey and white-grey, stand out as clearly as the several chromatic lines which together make up the basal plane of the color-pyramid.

We have sought to illustrate this relation of grey to black and white as follows. In preliminary work, the limits were determined of that range of middle greys which, under our conditions, was never transgressed by the observers as they watched white disappear from the light greys and black disappear from the dark greys. The center of this range was taken as neutral grey; the determination is, of course, only a rough approximation to fact. With this neutral grey the various colors which stand at the angles of the base of the color-

¹ Zur Psychophysik der Gesichtsempfindungen, *Zeit. f. Psychol. u. Physiol. d. Sinnes.*, X., 1896, 32 f.

pyramid, as well as black and white, were mixed in varying amounts on a Marbe color-mixer. The method of limits was used, and five series each of increasing and decreasing amounts of red, green, blue, yellow, black, and white were presented. The observer was given a sample of the hue or black or white which was added to or subtracted from the mixture, and was asked to say whether he saw any trace of this sample quality in the mixture. The averaged results may be regarded as rough chromatic limens. It is plain that the average values and their mean variations are all, despite the unfamiliarity of the task in the cases of black and white, of the same order of magnitude.

Obs.	H		S		T		W	
Colours	Av.	M.V.	Av.	M.V.	Av.	M.V.	Av.	M.V.
Red	13.9	1.18	15.7	1.2	12.	.9	14.4	1.2
Green	14.1	.72	16.6	1.1	12.7	1.04	13.9	1.1
Blue	11.6	1.28	12.9	.94	12.5	1.0	12.8	1.2
Yellow	12.9	.72	13.3	.96	14.3	1.3	15.6	.98
Black	13.6	1.8	17.1	1.32	14.3	1.44	14.6	1.3
White	13.8	1.56	17.9	1.3	14.6	1.2	15.1	1.1

Middle grey=300° Black+60° White.

Black=Hering Velvet Black; White=Hering Baryta White; Colors=Milton Bradley papers: Red, tint 1; Bluegreen; Blue; Yellow. Unit of variation=1.5°; unit of table=1°.

Observers: Dr. L. B. Hoisington, instructor in psychology; Miss A. Sullivan, fellow; Mr. S. Takaki and Mrs. A. K. Whitchurch, graduate students in psychology.

The conception of the blacks, greys, and whites as forming two qualitative series placed end to end, affords a clarification of theory. The color-pyramid stands as before, but its constituent qualitative series receive a new interpretation. The lines that converge upon central or neutral grey, from red, yellow, green, blue, black and white, are now of the same kind, chromatic or saturational series. Herefore, in order to account for the anomalous relation of black and white, as, at the same time, acting antagonistically in after-image and contrast and mixing to give intermediates, it has been necessary to postulate for them an unique type of qualitative series, composed psychophysically of three factors. No other example of this sort of series occurs, to our knowledge, in psychology.